How to Cruise Timber

A COMPLETE FIELD MANUAL

By JOHN W. SHAW

C. P. Cronk

How to Cruise Timber

Adapted for experienced cruisers loggers, foresters, claimants or for any one desiring to learn to estimate timber

A complete field manual, with diagrams and explanations of the Standard Methods of estimating timber

Explaining how to pace, how to run the compass, how to arrive at an estimate, how to make out a report, etc. with

A synopsis of the requirements for the general plan of surveying and the establishment of corners in public land surveys of the United States

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PRICE $1.00

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PREFACE.

It has often been remarked, that a knowledge of cruising timber cannot be obtained except by long experience in the woods. This is true to some extent in judging timber qualities and logging conditions, but far from true as regards the systematic methods of estimating and the hundreds of other necessary adjuncts to cruising. There are hundreds of men who have a thorough knowledge of timber qualities but have no idea as to how to arrive at the amount of timber standing on a piece of ground. With that fact in mind, and knowing how essential it is to have a carefully compiled manual for reference, this book was written.

The writer spent years in obtaining the knowledge necessary to be able to estimate, when if the same knowledge had been available in book form—such as a field manual always readily at hand—he could probably have become a practical cruiser in a few months, for he would have always had the written facts at hand to rely upon.

To timber estimaters in general, to those who intend learning to cruise, and to the hundreds of others interested in timber lands this field manual is submitted.

In compiling Part II, the author wishes to pay his respects to John W. Rowland of the United States Surveyor-General's office at Portland, Oregon for many valuable suggestions.

THE AUTHOR.

PART I.

CRUISING TIMBER

Cruising timber, is the act of reducing to board feet the amount of standing timber on a given area. There are several methods by which standing timber can be reduced to board measure and it is these methods and timber cruising in general that this book is intended to explain.

CRUISER'S OUTFIT.

The outfit of a cruiser should be selected to give the most comforts with the least weight. The following are the necessary articles: A No. 2 or No. 3 canvas pack, a light tent for long trips, necessary blankets, suit of paraffine for rainy weather, pair of the best make of boots, a two-pound axe, one hundred-foot tape with hook at end for measuring windfalls, one or two tallying registers for counting timber, supply of pencils and note books, celluloid pad, aneroid barometer capable of registering altitudes at a heighth of eight thousand feet, compass, and a copy of "How to Cruise Timber."

The two most important instruments in a cruiser's outfit are the aneroid barometer and the compass. The barometer, as has been stated above, should be capable of registering altitudes at an elevation of eight thousand feet. It should be of reliable make and will cost about twenty dollars. There are two kinds of compasses, the box compass and the sight compass. The box compass is a small instrument as compared with the sight compass, intended to be used without staff, and to be set while held in the hand. It is not as accurate as the sight compass but has been used to good advantage for many years. The standard size box compass is the one with the 2¼-inch needle; it will cost about three dollars. The sight compass is more expensive and should have a needle of at

least 3½ inches. It should be equipped with movable dial and vernier and provided with Jacob staff and level head. It will cost from sixteen to twenty dollars.

GETTING LOCATED.

Before leaving for the land from the nearest store or settlement inquire for trails, roads, cabins, and for the section corner nearest the land you intend to examine. If you are not fortunate enough to find some one who can give you this information, consult your blue-print or map and try to get your location by the streams—looking all the while for a line or corner.

MAKING CAMP.

Having arrived at a point handy to your land look around for a place suitable for a camping ground. In the summer months look for some shaded nook; in winter for a place where the drainage is good and where there is no danger of falling snags or limbs. Build your fire where there is no chance of it running, and at all times away from logs or trees and never go away and leave it burning. Gather plenty of boughs for your bed, making yourself as comfortable as possible and remembering that the best woodsman is the one who can make the most of the least at hand. Cook your food well, make yourself generally handy around camp and don't let your companion do all the work.

SETTING THE COMPASS.

The first thing to do before trying to set your compass is to determne the variation (See "Declination of the Magnetic Needle," Part II). If you are using a box compass, take the instrument in both hands, thumbs on edge of dial and forefingers under the lid that you sight over, and stand facing the direction you wish to run. Now, with your elbows set firmly against your sides, allow the needle to settle at the

proper point, and get your sight from the line across the lid of the box. The method most commonly used in settling the needle, is to tilt the compass slightly so as to allow the positive end of the needle to rest firmly against the bottom of the dial near the point of variation, and then slowly, by bringing your compass to a level, allow the needle to rise and settle at the proper point.

Upon examining your instrument you find that the letters E and W on the dial are reversed as to the relative directions they represent. Say, for example, that you are running on a variation of twenty degrees east, then the positions for the needle for each point of the compass would be as follows: When running north, the positive end of the needle should point 20° east of the symbol for north; when running east, it should point to the figure 70 just 20° east of the letter E; when running south, it should point to the figure 20 just 20° east of the letter S; and when running west, it should point to the figure 70 just 20° east of the letter W.

To use the sight compass first set the Jacob staff firmly in the ground, slanting it away from you or in the direction you wish to run, then after slipping your compass onto the level head, which should be firmly fastened to the staff, level the instrument and turn it until the needle points to the proper figure on the dial.

RUNNING THE LINE.

You are now ready to run the line. Your compass being set the sights point to some tree or object ahead. Look for something about the tree or object that is different from other trees or objects; for example, bark markings, odd shaped limbs, hanging foliage, a leaning tree near by, or anything that will identify your sight tree and don't loose your sight at all odds. In timber, so many trees resemble each other, and if you are not careful you will soon be running toward the wrong tree. Many times you will encounter brush thickets,

which are unavoidable, but do not step off the line or fail to recognize your sight tree upon coming out at the other side. If you are in doubt as to the tree you should pace to, set your compass again and you will immediately recognize it. Don't try to take too long a sight unless you are running in clean open timber, then the longer the better.

PACING.

Pacing is the cruiser's method of measuring land and distances. Practice and painstaking effort are the essentials for accuracy in pacing. A pace is not a long step nor a short one, but a stride two feet and sixty-four hundredths (2.64) in length. In pacing, try to step the same distance each step; if there is an obstacle in your path—such as a log or brush heap—don't try to step upon it, and then off and call it two paces, but measure with your eye for the proper distance and for the number of paces it will require.

On ascending steep hills where it is impossible to take a full step, step twice for one pace, not long steps that would require great effort but short steps that you would naturally take in climbing a hill; in descending, use the same method. Where the grade is only slight, pace as on level ground, using your own judgment as to how often you should pace twice for one. Don't try to walk too fast, careful work is the best time saver.

TABLES.

SURVEYOR'S TABLES.

7.92 inches .....1 link
100 links .....1 chain
80 chains .....1 mile

16 sq. rds.....1 sq. chain
10 sq. chains.....1 acre
640 acres ..... { 1 sq. mile / 1 section
36 sections .....1 township

Long Measure.	Square Measure.
12 inches .....1 foot	144 sq. inches ....1 sq. foot.
3 feet .....1 yard	9 sq. feet .....1 sq. yard
5½ yds. or 16½ ft.....1 rod	30¼ sq. yards or..
320 rods .....1 mile	272½sq. ft. .....1 sq. rod
	160 sq. rods or..
	43,560 sq. ft. .....1 acre

CRUISER'S HANDY TABLE

1 pace	2.64 feet	¼ mile	1320 feet 80 rods 4 tallys 20 chains
1 rod	6¼ paces 16½ feet		
1 chain	66 feet 4 rods 25 paces	½ mile	2640 feet 160 rods 8 tallys 40 chains
1 tally	330 feet 20 rods 125 paces 5 chains	1 mile	5280 feet 320 rods 16 tallys 80 chains

RULE FOR FINDING THE CONTENTS OF LOGS.

Rule: The contents of a 20-foot log is the square of the diameter of the small end under the bark, less three and a half times the diameter.

Example. What is the contents of a log 32 inches in diameter and 20 feet long?

32
32

64
~~96~~
96

1024—Square of diameter.
112—Less 3½ times diameter.

912—Amount in 20-foot log.

To find the contents of a 16-foot log reduce the 20-foot log to 80% of itself; i.e., multiply by 8 and cut off the right hand figure.

CRUISER'S LOG TABLE.

The first rows of figures in the following table, represent the diameters of logs measured at the small end under the bark; the second rows represent the contents of one foot of log of those diameters from which you can readily find the contents of any length of log; the third rows give the values of 16-foot logs of the given diameters.

Diam.	1 ft. of log	16 ft. log	Diam.	1 ft. of log	16 ft. log
6	.75	12	64	193.6	3,097
7	1.2	19	65	199.8	3,197
8	1.8	29	66	206.2	3,300
9	2.4	39	67	212.7	3,403
10	3.2	52	68	219.3	3,508
11	4.1	66	69	225.9	3,615
12	5.1	81	70	232.7	3,723
13	6.1	98	71	239.6	3,834
14	7.3	117	72	246.6	3,945
15	8.6	138	73	253.6	4,058
16	10	160	74	260.8	4,173
17	11.4	183	75	268.1	4,290
18	13.1	210	76	275.5	4,403
19	14.7	235	77	282.9	4,527
20	16.5	264	78	290.5	4,648
21	18.3	294	79	298.2	4,771
22	20.3	325	80	306	4,896
23	22.4	358	81	313.8	5,021
24	24.6	393	82	321.8	5,149
25	26.6	429	83	329.9	5,279
26	29.2	468	84	338.1	5,409
27	31.7	507	85	346.3	5,541

Diam.	1 ft. of log	16 ft. log	Diam.	1 ft. of log	16 ft. log
28	33.3	532	86	354.7	5,676
29	36.9	591	87	363.2	5,811
30	39.7	636	88	371.8	5,948
31	42.6	682	89	380.4	6,087
32	45.6	729	90	389.2	6,228
33	48.6	778	91	398.1	6,370
34	51.8	829	92	407.1	6,513
35	55.1	882	93	416.1	6,657
36	58.5	936	94	425.3	6,805
37	61.9	991	95	434.6	6,954
38	65.5	1,048	96	444	7,104
39	69.2	1,107	97	453.4	7,255
40	73	1,168	98	463	7,408
41	76.8	1,228	99	472.7	7,563
42	80.8	1,293	100	482.5	7,720
43	84.9	1,358	101	492.4	7,878
44	89.1	1,425	102	502.3	8,037
45	93.3	1,493	103	512.4	8,198
46	97.7	1,564	104	522.6	8,361
47	102.2	1,635	105	532.8	8,525
48	106.8	1,708	106	543.2	8,691
49	111.4	1,783	107	553.7	8,859
50	116.2	1,860	108	564.3	9,028
51	121.1	1,938	109	574.9	9,199
52	126.1	2,017	110	585.7	9,371
53	131.1	2,098	111	596.6	9,545
54	136.3	2,181	112	607.6	9,721
55	141.6	2,268	113	618.1	9,890
56	147	2,352	114	629.8	10,077
57	152.4	2,438	115	641.1	10,257
58	158	2,528	116	652.5	10,440
59	163.7	2,619	117	663.9	10,623
60	169.5	2,712	118	675.5	10,808
61	175.3	2,805	119	687.2	10,995
62	181.3	2,901	120	699	11,184
63	187.4	2,998			

CONTENTS OF TREES.

A timber estimator takes as his unit of length, a 16-foot log, and divides his standing timber into as many log-lengths as it will cut. After knowing how many logs long a tree is, it is then necessary to know what the taper is of that tree, so that an average log may be obtained and the contents of the tree figured out; or better still, so that each log may be scaled separately. We know that trees do not taper gradually, so at best in computing a standing forest, we can only take sample trees with tapers characteristic of that particular timber and make our estimate of the average tree from this data. It is plain that no estimator could ever, separately, get the contents of each tree as it stands in the forest, without consuming a great amount of time and incurring too much expense to his employer; so he can only carefully grade the timber with his eye as he passes through and then determine what the contents should be for the average tree of each grade he has found.

There are several methods employed by the cruiser for obtaining the contents of these average trees: One method, is to obtain the average log by dividing the sum of the diameter of the first log (small end) and top log, by 2; then, multiplying the number of board feet in this log by the number of logs in the tree. Another method, is to arrive at the taper from sample down-trees and scale each 16-foot log separately. Still another method, is to obtain your amounts from volume tables of which there are several published, and which show the values for the entire tree of the given butt measurement and length.

GRADING TIMBER.

To intelligently make a report after the field work has been done, the cruiser must have data from the examinations made, that will give the one reading the report a clear idea

as to the conditions found. Nothing is more essential to a report than the size and quality of the timber and the grading of the same.

Yellow fir, and timber of similar growth, should always be returned in at least three sizes; that is, the per cent of each grade found. Red fir can be returned in two sizes, provided the timber is all under 40 inches butt measurement, and three, if any great amount of the stand exceeds 40 inches—in both cases, piling should be recorded separately. Where there is only a small percentage of some one species, mixed with the predominating variety of timber, it is not necessary to grade that species but only return the average size.

THE AVERAGE TREE.

When a cruiser has made a count of an acre or more of ground and finds that he has a number of trees recorded, he should then know what the average tree is of that count, or the average tree of each grade if he is grading the timber. One method is to measure every tenth or twentieth tree recorded, or the equivalent thereof; this is done by having the compassman measure the required number of trees at the end of each tally. Another method is to make careful measurement of all the trees on sample acres through the tract, thus obtaining the average tree, or the graded sizes, at your option. A better method is to throw your timber into grades as you travel through the stand, and record by ocular measurement, the exact number of trees that will fall within each grade.

THINGS YOU SHOULD KNOW.

Surface clear, is the portion of a tree free from knots, limbs, or defects of any kind.

Trees 36 inches in diameter and up, and from 50 to 65 per cent surface clear, will cut one and two flooring logs, two to four No. 1 merchantable logs, and one or more No. 2 merchantable logs; logs in this case understood to be 32 feet in length.

Trees do not taper as much under the bark as outside the bark.

Bark of yellow fir is soft and thick, while that of red fir is hard and thin, so be careful of your butt measurements.

Down yellow fir will last many more years than dead-standing; dead-standing, if fire killed, will be sound from eight to fifteen years. Fire killed red fir of good size will remain sound from three to eight years. Fire killed hemlock will remain sound for three years.

The percentage of breakage in falling timber depends so much upon the conditions prevailing and the skill of the faller that only close observation can guide the cruiser in making the proper deductions. It is obvious that there would be more loss from breakage in falling on very broken or stony surface than upon smooth soil; however very old, green yellow fir, and fire killed or dead timber, will have much loss from breakage on the best of ground.

The standard railroad tie is eight feet long; they are cut in several different sizes, according to order. The following table is self-explanatory:

Dimension	Contains	No. of Ties to M.
6x8	32 board feet	31.25
7x9	42 board feet	23.8095
7x8	37 board feet	26.7859
6x9	36 board feet	27.7777

In figuring standing timber into cordwood, a thousand board feet as contained in a log is equivalent to a cord of wood. There must, however, be allowance made for bark, limbs, and the tops of the trees; this sometimes amounting to a 25 per cent increase, where there is thick bark and a heavy growth of limbs.

Having explained the manner of finding the contents of logs and trees, we will now explain in a general way how the cruiser's work is done—explaining the different methods later.

Starting through the timber with tape and tallying registers at hand the cruiser walks from ten to twenty-five paces behind the compassman, keeping him always in sight. At first you proceed very slowly, as you wish to measure many trees in order to be sure of your sizes and to train the eye; then, as you become more familiar with the stand of timber you are estimating, your speed increases. It matters not what distance from you, on each side of you, you are counting, it is always best to pace off frequently—or rather, have your compassman do so—for the exact distance. You have now, we will say, traveled one tally, and have a count of the number of trees for a certain width in that distance; you will then record on your celluloid pad, the trees in their proper grades and lengths, being careful to mark plainly on the leaf of the pad the description of the forty-acre tract you are estimating. Thus you continue, making a record of your count at the end of each tally, or until you have gone the length of four tallys or across the forty-acre tract.

Work the land to the very best advantage, taking into consideration the roughness of the ground and the difficulties to be encountered in traveling. Do not try to do too much for a day's work, for your employer will be satisfied with two or three miles of estimating per day, provided he knows the work is being well done. At night when you return to camp, compute your records for the day so that you can always be ready with your final reports when called upon.

A study of the different methods of cruising, as illustrated and explained on the following pages, will give a clear idea of the principal methods in use today. In cruising, by count-

ing a certain number of acres out of each forty-acre tract to base your estimate from, the writer prefers the strip-acre method as described and illustrated under diagram A; it is simple, the most accurate, and the best method for saving time. It is best, however, for the beginner to understand all of the methods herein described.

DIFFERENT SYSTEMS OF CRUISING.

To specifically explain the different methods of making an estimate of a forty-acre tract, the following diagrams with their explanations, have been prepared by the author:

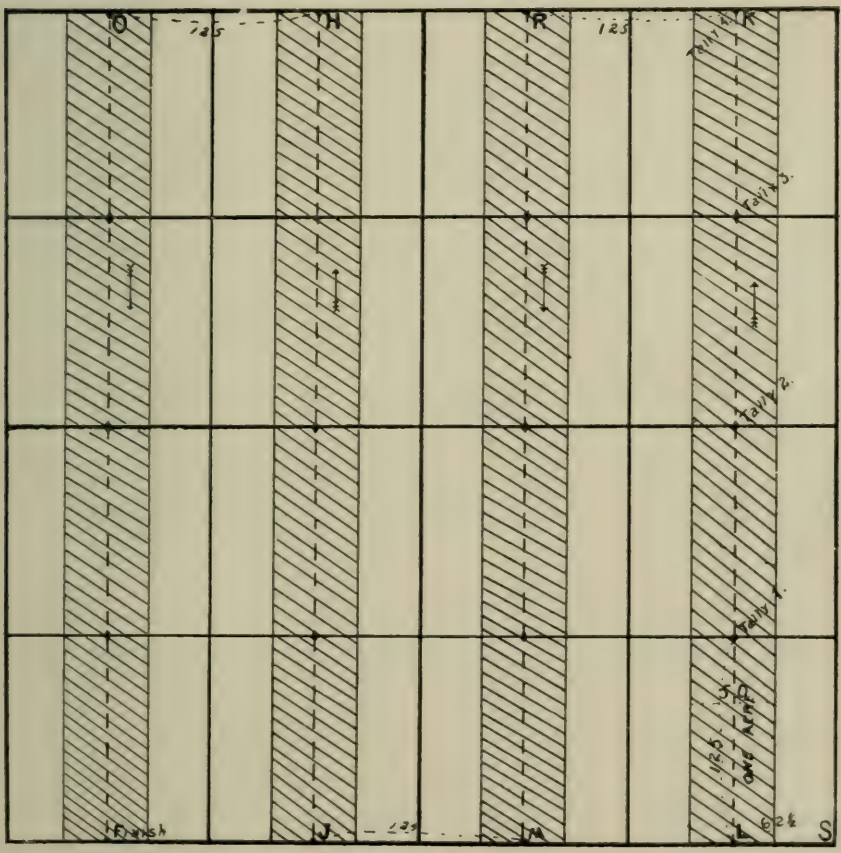


DIAGRAM A.

Diagram A, represents a forty-acre tract. The heavy lines crossing at right angles, subdivide the forty acres into sixteen parts, of 2½ acres each, and the shaded portions represent the part of the land which the cruiser actually counts—the arrows showing the direction he travels, and the dotted lines, the exact lines the compassman runs. This diagram explains the method known as the strip-acre method of cruising; and by which the cruiser obtains (actual count) one acre out of each 2½-acre tract, or 16 acres out of the forty.

Beginning at S, pace in 62½ paces to L, then 4 tallys (500 paces) to K, counting all the timber 25 paces on each side of you as you go, and recording the number of trees of the different grades you are making, at the end of each tally, noting the average length of the trees in 16-foot logs, on each 2½-acre tract. Arriving at K, pace 125 paces (one tally) to R and thence to M, to J, to H, to O, and finish.

By this method you only obtain two-fifths of the actual amount of timber on the forty, to make your estimate from. Care should be taken to get a fair average of the amount on each 2½-acre tract. Should your cruising line not extend through a fair average of the 2½-acre tract count all the timber, getting the average tree and reducing the whole amount to two-fifths. Thus you have a separate estimate on each 2½-acre tract, and your tally sheet should show, approximately, the whole number of trees, with their sizes, on each of these tracts.

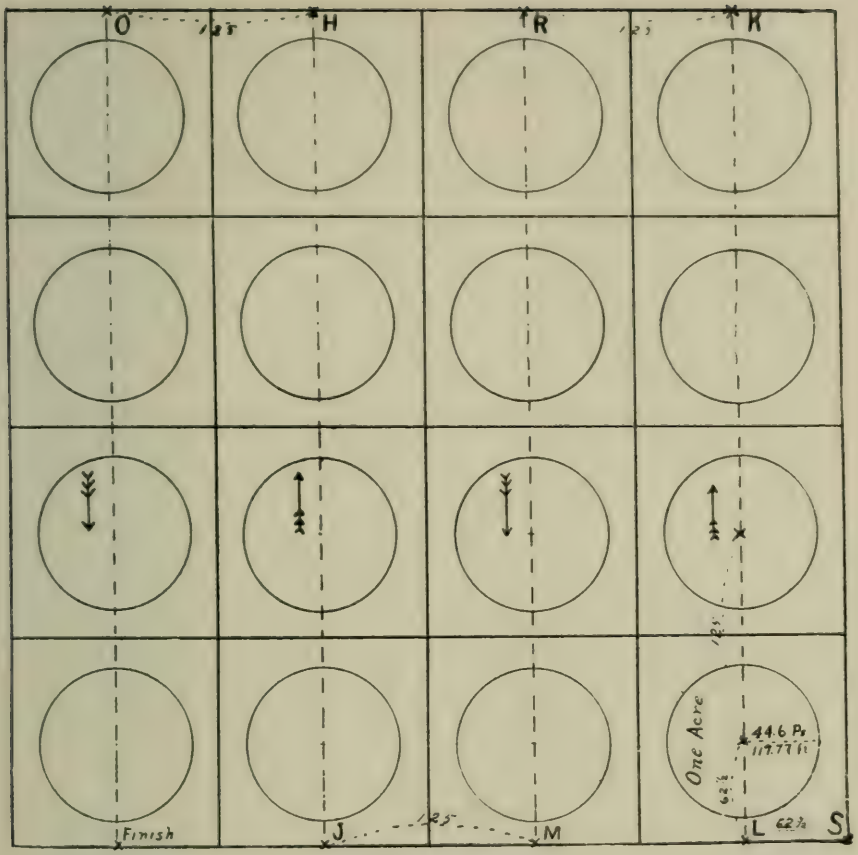


DIAGRAM B.

Diagram B, represents the method of cruising a forty-acre tract, by the circle-acre system. The lines are run through the forty the same as in diagram A—the cruiser stopping at the center of each 2½-acre tract, and counting an acre in a circle. A circle-acre, is all land embraced in a circle with a radius of 117.77 feet or 44.6 paces from a given center. As in the

method described under diagram A, you should count all the timber in a 2½-acre tract, if the circle-acre does not fall in a fair average of the timber on that tract. When you have finished you will have 16 acres actual count or two-fifths of the timber.

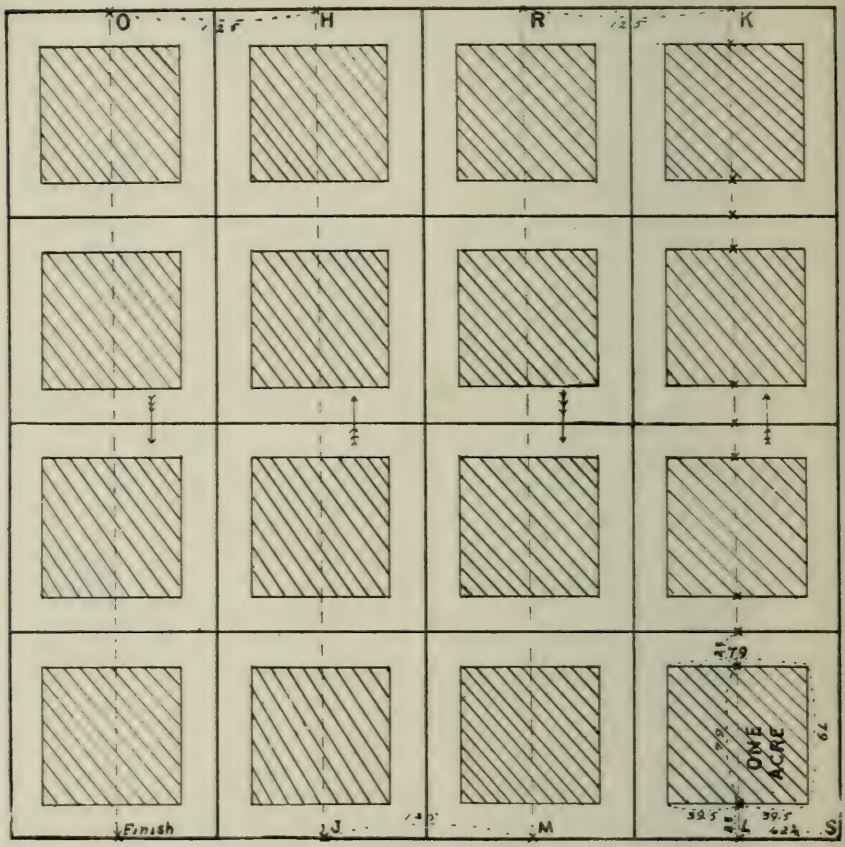


DIAGRAM C.

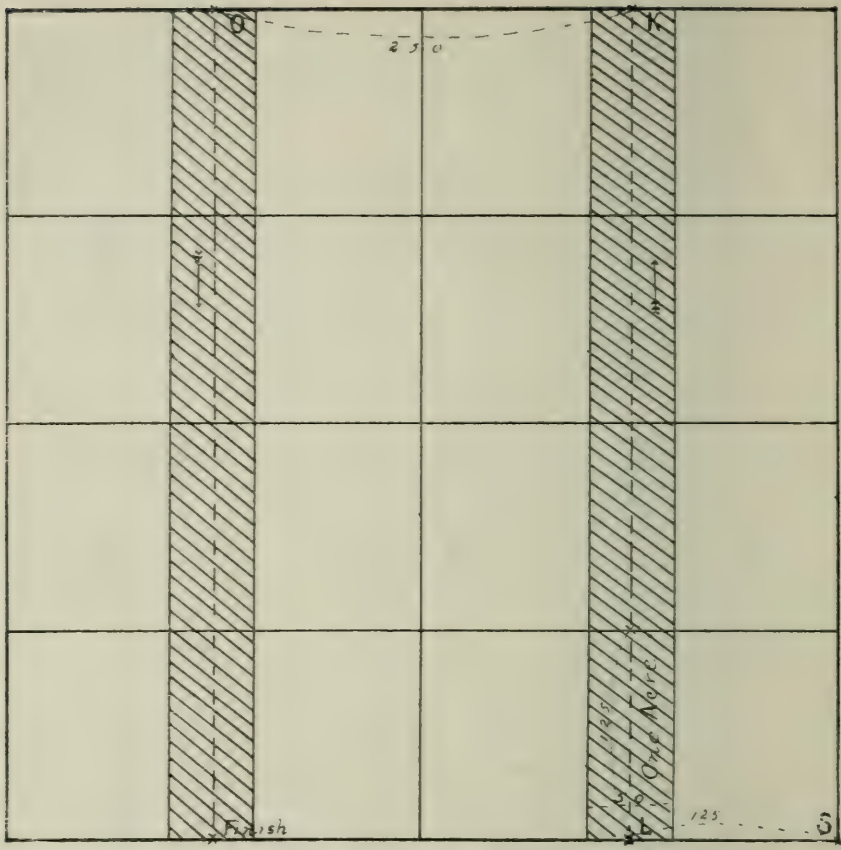
Diagram C, represents a forty-acre tract and the method of cruising it by the square-acre system. The cruising lines are

run identically the same as in diagram A, the method being almost the same as the circle-acre system, except: that after arriving at L from S, the compassman announces the first 23 paces stepped off on the cruising line, and then paces 79 steps more (the width of the square acre), and then again 23 paces to the end of the tally. The cruiser, following the compassman, does not begin to count timber until the first 23 paces are stepped off; then he counts the length of the acre (79 paces), covering 39.5 paces on each side of him. Thus the cruiser continues through each 2½-acre tract until all 16 are counted, giving him two-fifths of the timber.

As in the circle or strip-acre methods, if the square acre does not fall upon a fair average of the timber in the 2½-acre tract, count all the timber in that tract, getting the average tree and bringing the number of trees down to two-fifths. To make it more clear, the square acres to be counted are represented by the shaded portions on the diagram, and the figures given between the crosses are the distances in paces between such points.

Most of the timber on the Pacific Coast has been cruised by only double-running each forty; i.e. obtaining a count of eight acres out of each forty, from which to make the estimate of the whole amount on the tract. In preliminary work, the cruiser only makes a single run of each forty, thus only obtaining a general idea of the stand and quality of the timber, which if satisfactory, will later be thoroughly cruised.

Tracts may be double-run by any of the systems described on these pages. The method of double-running, is to pace in 125 paces from the corner of a forty-acre tract, and run two parallel cruising lines through the forty in such a manner, that you will at all times be able to see a tally on each side of you—that you may not escape any of the important data or features of the land or timber. The following diagram (D), illustrates a double-run by the strip-acre method of cruising:



THE TREE-COUNT SYSTEM.

By the tree-count system we mean an actual count of every merchantable tree on each forty-acre tract. In ordinary yellow pine or not too dense fir, the timber can be counted by running each forty four times, counting all timber on each 2½-acre tract (62½ paces on each side of you) at one run. However, should the timber have a very heavy and dense growth of underbrush, or stand more than 50 M. per acre, the forty

should be run eight times, making an actual count 31¼ paces on each side of you.

The first thing to do before beginning to cruise by this method, is to run out and plainly blaze the section lines; also to run a line across the center of the section connecting two quarter-section corners which stand on parallel section lines—as you should always run your cruising lines parallel, to parallel section lines if possible. As the section lines are run and blazed, stake off on two sides of the section, the points where your cruising lines should begin and end. This is done so you can be absolutely sure you are running your cruising lines parallel to one another and not be recounting the timber.

This work should always be done with a sight compass. The true variation of the magnetic needle should be very carefully determined from the field notes, or be obtained when running the parallel section lines.

In making the necessary calculations for the average size tree on each 2½-acre tract, cruisers use different methods; some getting the average size tree by having the compassman measure every tenth or twentieth tree counted, and others obtaining their average by getting the actual size of every tree on sample acres throughout the forty. By the first method, the compassman—using the Jacob staff as a rule—measures the number of trees near the cruising line, designated by the cruiser as being equivalent to one for every ten or twenty trees counted. In using the tree-count system of cruising the cruiser should take up his timber every half tally (62½ paces), and when finished, will have an actual count of every merchantable tree on each forty, showing the average size and length of same.

ACREAGE.

By examining your blue-print of a township, you will notice that the excess or deficiency in acreage (explained in Part II)

is generally along the north and west boundaries of the township. These are known as lots, and contain more or less than forty acres as the case may be. On the north tier the lots are exactly 20 chains (80 rods) wide from east to west, but are more or less than 20 chains from north to south. The lots on the west boundary of the township, are exactly 20 chains wide from north to south but are more or less than 20 chains from east to west. Now, if a lot is 80 rods in width, every strip 2 rods wide across that width will contain an acre, or 160 square rods. Reducing rods to paces, every strip 12.5 paces wide and 4 tallys (80 rods) long will contain an acre. To determine the number of paces long a lot would be, when it is 80 rods wide, multiply the number of acres in the lot by 12.5. Example: How many paces long is a lot 80 rods wide and containing 46.80 acres:

```
  46.80
   12.5
 -------
  23400
  9360
 4680
 -------
585.000 paces.
```

The area of an acre, is 43,560 square feet or 6,250 square paces.

A square acre, is 79.057 paces square.

A circle-acre, is all embraced in a radius of 117.77 feet or 44.6 paces from a given center.

One-third of an acre contains 14,520 square feet or 2,083 square paces.

One-third of an acre in a circle, is all embraced in a radius of 68 feet or 25.78 paces from a given center.

Acres in a rectangle may be: 100x62½ paces or 125x50 paces.

For the convenience of the cruiser, the following rules are given:

To find the circumference of a circle whose diameter is known. Rule: Multpily the diameter by 3.1416.

To find the diameter the circumference being known. Rule: Divide the circumference by 3.1416.

To find the area of a circle, the diameter being known. Rule: Multpily the square of half the diameter by 3.1416.

To find the area of a circle, the circumference being known. Rule: Divide the square of half the circumference by 3.1416.

To find the area of a circle, the circumference and diameter both being known. Rule: Multiply the circumference by one-fourth of the diameter.

To find the diameter or circumference of a circle, the area being known. Rule: Divide the area by 3.1416, the square root of the quotient will be equal to half the diameter; and the diameter multiplied by 3.1416 will equal the circumference.

CALCULATING THE CONTENT.

To culculate the content of differently shaped pieces of land the following rules are given:

1. Rectangle. The content of a rectangle is found by multiplying its length by its breadth.

2. Triangle. In computing the area of a triangle, either side may be assumed as the base and the altitude will be the perpendicular let fall from the vertex of the angle opposite upon the base. To be more clear, the perpendicular is the shortest distance from the base to the opposite angle.

To find the content of a triangle, multiply the base by one-half the altitude and the product will be the area.

3. Parallelogram. A parallelogram is a four-sided figure whose opposite sides are parallel. The content of a parallelogram equals the product of one of its sides by the perdendicular distance between it and the side parallel to it.

4. Trapezoid. A Trapezoid is a four-sided figure, of which two opposite sides only, are parallel. The content of a Trapezoid equals half the product of the sum of the parallel sides by the perpendicular distance between them.

5. Trapezium. A four-sided figure, none of whose sides are parallel. Divide the Trapezium into two triangles by running a line across it from corner to corner, and then find the content of each triangle, as in 2.

MAKING A REPORT.

A cruiser's report is a record of the cruiser's work. It should contain everything necessary to convey a clear idea as to the exact conditions of the land and timber. In former years owners of timber were satisfied to receive a report showing only the amount of timber on each forty-acre tract, regardless of the size of timber found, and were satisfied if the land was only double run; but at the present time—values being much higher—the most complete returns are none too good.

Have your compassman keep a complete record of such things as: streams and their courses, hills and their slopes, aneroid readings, clearings and burned areas, and the general condition of the land. The following diagram subdividing the different sections of a report blank, will be helpful in making a complete report:

Size and quality of timber.	Species. Average size and length of trees. Amount of surface clear. Age of timber. What per cent of defect?

Distance to drivable stream or railroad.	How large a stream? Into what does it empty? Has it ever been driven? Is there plenty of water for fluming? Distance from railroad.
Logging conditions favorable or otherwise.	What is the general slope of the ground? How steep? Is the soil rocky or swampy? Are there many ravines? Is the tract divided by high ridges? Is the timber isolated? Does any burned timber surround it? What chance for mill site and fluming? Feasibility of logging railroad.
Damage by fire.	State the extent of fire damage. How many years since burned?
Probabilities of fire.	Dampness of ground. Growth of underbrush. Condition of surrounding growth. State is much dead brush or down timber.
Kind and value of land when denuded.	Quality of soil. Bottom land if any. Suitability of land. Value of land.
General remarks.	What is the timber best adapted for? State if any small timber not counted. If any wagon roads or trails. How you classed your timber. How many times you run each forty. What defects you found if any. Location of buildings, fences or clearings.

The topography of a tract of land is a detailed description of that land shown by representation.

A topographic map is one which shows with practical accuracy, all the drainage, improvement, and relief features which the scale of representation will permit. By drainage, we mean the water courses; i.e. rivers, creeks, ponds, lakes, etc. By improvements, we mean the results of human efforts; clearings, slashings, fences, roads, trails, railroads, houses, barns, mills, etc. By relief features, we mean the contour of the land; the profile or outline of the surface of the land.

The topographic map is of great value to a report. If carefully drawn from your notes taken in the field, it will be an exact reproduction of the surface conditions reduced to scale; in other words it will be a picture, or birdseye view of the land. A study of the methods of representation and how to make a neat topographic map are important adjuncts to a cruiser's fund of knowledge. Be careful not to overlook anything in the field and by making notes in your notebook, or on your blank diagram of sections in your estimate book, you can keep an accurate record of all things necessary for making a complete map.

Take your aneroid readings at the top of each ridge and at the bottom of each ravine, wherever you cross them with your cruising lines as you pass back and forth through the forty. If you are cruising an entire section, take readings at each section corner; and if only part of a section, at the corners touching the land you are cruising.

PART II.

SURVEY OF THE PUBLIC LANDS OF THE UNITED STATES.

The regulations for the survey of the public lands of the United States, adopted by Congress, are made to conform to the meridians and parallels of the earth.

In various sections of the country points were established known as initial points; and from each of these points a principal meridian, conforming to a true meridian and a base line, conforming to a parallel of latitude, were run north and south and east and west respectively, from which all surveys in that particular part of the country were made. North and south of the base line, and parallel to it, lines were established twenty-four miles apart known as standard parallels; and east and west of the principal meridian, guide meridians, with the same space intervening, were fixed.

After the establishment of these principal lines, the land was divided into tracts six miles square known as townships. These townships were subdivided into thirty-six parts of one mile square each, known as sections. Beginning at the northeast corner of the township and numbering from left to right in each tier, the sections were numbered consecutively from one to thirty-six. Corners were established at each of the corners of a township, at each of the corners of the sections and at intervals of one-half mile from each section corner, so that the land could be easily found by the settler and its boundaries definitely located. To designate the location of a township, as it relates to the principal meridian and base line, it is necessary to have some system by which each township is known. When we say, township 3 south, we mean that the township in question is in the third tier of townships south of the base line. This does not definitely locate it, so we deter-

mine in what range tier it is, east or west of the principal meridian. Supposing the range tier to be 7 east, then we would say: Township 3 south, range 7 east.

The following table shows the location of the standard parallels in Oregon and Washington:

OREGON.

Name	West of Cascade Mts.	East of Cascade Mts.
1st North	Bet. Tps. 4 and 5 N.	Bet. Tps. 4 and 5 N.
1st South	Bet. Tps. 5 and 6 S.	Bet. Tps. 5 and 6 S.
2nd South	Bet. Tps. 10 and 11 S.	Bet. Tps. 10 and 11 S.
3rd South	Bet. Tps. 13 and 14 S.	Bet. Tps. 15 and 16 S.
4th South	Bet. Tps. 18 and 19 S.	Bet. Tps. 20 and 21 S.
5th South	Bet. Tps. 22 and 23 S.	Bet. Tps. 25 and 26 S.
6th South	Bet. Tps. 27 and 28 S.	Bet. Tps. 30 and 31 S.
7th South	Bet. Tps. 32 and 33 S.	Bet. Tps. 35 and 36 S.
8th South	Bet. Tps. 35 and 36 S.	Bet. Tps. 39 and 40 S.
9th South	Bet. Tps. 39 and 40 S.	

WASHINGTON.

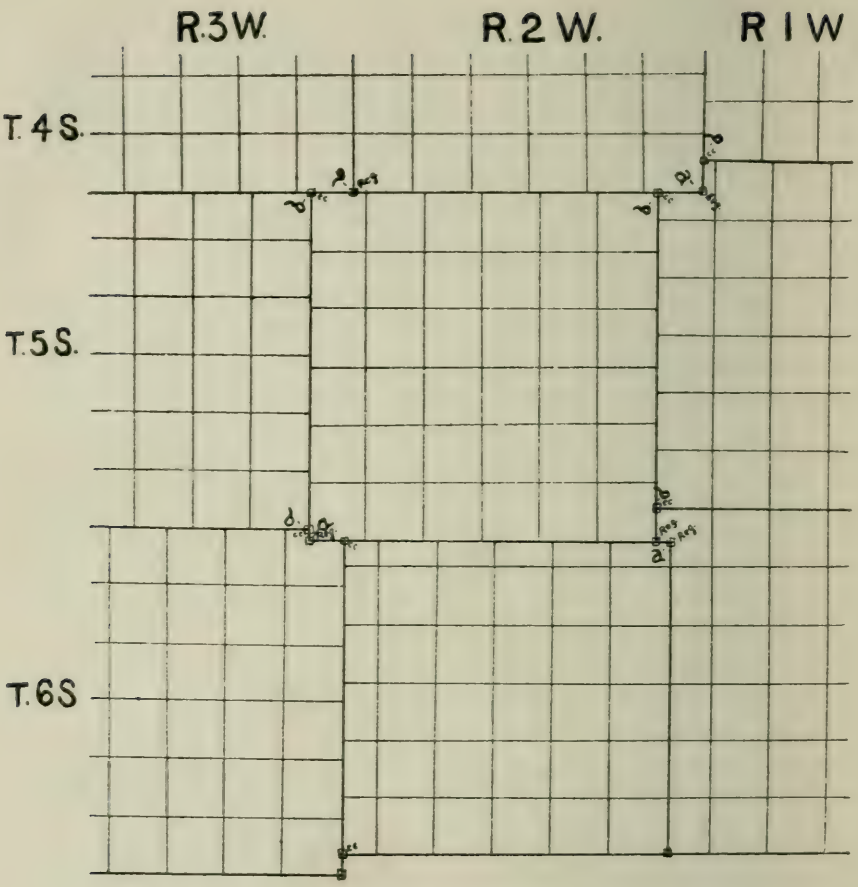
Name	(Extend entirely through State)
1st North	Bet. Tps. 4 and 5 North
2nd North	Bet. Tps. 8 and 9 North
3rd North	Bet. Tps. 12 and 13 North
4th North	Bet. Tps. 16 and 17 North
5th North	Bet. Tps. 20 and 21 North
6th North	Bet. Tps. 24 and 25 North
7th North	Bet. Tps. 28 and 29 North
8th North	Bet. Tps. 32 and 33 North
9th North	Bet. Tps. 36 and 37 North

If you will examine an ordinary schoolroom globe you will notice that the meridian lines of the earth drawn from pole to pole, are farthest apart at the Equator, and that they come

closer together as they approach the poles; i.e., their convergency increases as we go south or north from the Equator. This being true (we being north of the Equator), if we make our surveys to conform to true meridians, each township will be narrower at the northern than at the southern border; it will then make them, not a square, but a trapezoid. In surveying, this is what is known as convergency.

If a township was perfectly square, it would contain 36 full sections of 640 acres each, or 23,040 acres; but owing to convergency they may be more or less as the case may be. It is required by law, that the excess or deficiency in acreage shall fall upon the north and west boundaries of a township; i.e., a surveyor in subdividing a township, finishes his lines at the north and west sides and throws the excess or deficiency of the length of his lines between the last quarter-section corner, established, and a point where the line he is surveying intersects the township line thus closed upon. The surveyor is required to make the length of the lines between section corners, eighty chains, and the quarter-section corners must be established at an equidistant point between such section corners—except on lines of sections on the north and west sides of a township, as noted above.

By examining Diagram 1, you will notice that townships, owing to various irregularities, do not always come together at common corners, but that they sometimes corner in such a manner that the corners which limit their boundaries relate to one, two, or four townships as the conditions may require. In the diagram, the corners (b) represent township corners common to two townships only, and corners (a) represent corners which refer to one township only. You will also find that townships are not always subdivided as a theoretically perfect township should be, but that fractional tracts are sometimes thrown on different sides or parts of a township.



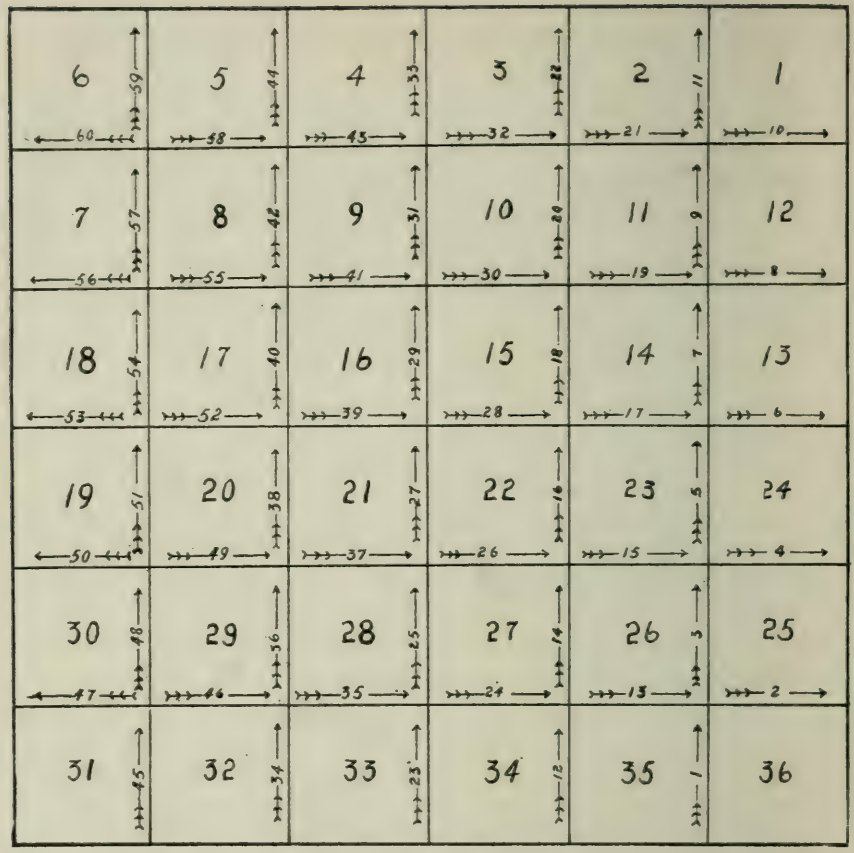
TOWNSHIP EXTERIORS.

As originally intended, blocks of land 24 miles square were to be surveyed, making 16 townships in a block. Owing mostly to the difficulties that arose in opening up new country, this has not been carried out, and the result is that the standard parallels and guide meridians have not always been placed

at the proper interval. (See table of standard parallels in Oregon and Washington.)

The exterior lines of a township are often established under separate contract from that of subdividing the interiors. In making these exterior surveys the meridional boundary lines always have precedence—being established on true meridian lines—while the latitudinal township lines are first run on random or trial lines, and then corrected back on true lines which fit the requirements. While these lines are being run, the regular section and quarter-section corners are established, to be later used as guides in subdividing.

If in running the lines of the boundaries of a township, the lines should fall short of, or overrun the correct aggregate of those lines more than three chains (making due allowance for convergency), then parts or all of those lines are retracted to correct the error; and should the last line run fall to the right or left of the objective corner more than three chains, then as before the error must be corrected.



TOWNSHIP INTERIORS.

After the exterior lines of a township are run, the surveyor then subdivides the same into sections of one mile square each. The lines running north and south are made to comply with true meridians and those running east and west are in conformity with parallels of latitude. If correctly run, the exterior line on the east side of the township to be subdivided is a true meridian, and the meridional lines subdivid-

ing the township (section lines) will be run parallel to this exterior line. It must be noted, however, that often discrepancies or gross errors exist in the establishment of this east boundary which cannot be corrected, in which case the surveyor would run the meridional section lines of the extreme eastern tier of sections as true meridians, and all other meridional sectional lines within the township parallel to these lines; throwing the fractional acreage upon the east side, as well as upon the north and west sides of the township.

We will say, for example, that the eastern boundary of a township is correct as to requirements; then the surveyor would subdivide that township by the following method:

Starting at the corner to sections 35 and 36, on the south boundary of the township, the first section line (80 chains long) of the subdivision is extended northward parallel to the eastern boundary of the township. At forty chains on the line a quarter-section corner (¼S.) is established and at eighty chains a section corner for sections 25, 26, 35 and 36 (see diagram 2). Now, turning eastward, it is the surveyor's object to run a section line parallel to the south boundary of the township and strike the objective corner already established on the east boundary. In order to do this, the surveyor runs this line as a trial or random line as he extends it eastward, placing at 40 chains a temporary quarter-section corner and noting the distance his line falls north or south of the objective corner, calculates the correct course by which to return westward by a true line. Upon running the random line no blazes are made upon the trees, but upon returning on a true line, the line is plainly marked to comply with the regulations and the quarter-section corner is made permanent at the proper point.

Thus, the west and north boundaries of the eastern tier of sections are established, until the line to be run from the

corner to sections 1, 2, 11 and 12 to the north boundary of the township, is reached; then, this line between sections 1 and 2, is projected northward on a random line parallel to the east boundary of the township, the surveyor setting a post for a temporary quarter-section corner at forty chains and noting the point where his trial line intersects the township boundary. Returning upon a true course, the surveyor obtains by measurement the exact distance from the township line to the true point for the quarter-section corner, thus throwing the excess or deficiency of the length of the line in this space, and thereby leaving the fractional acreage of section 1 on the north boundary. It often happens that it is impossible for the surveyor to intersect the township line within the prescribed limits of 50 links distance of an established corner, in which case a new corner would be established, known as a closing corner.

By this manner each successive tier of sections running from north to south is surveyed, until the fifth tier is reached; where, from the section corners established on the west boundary of this tier of sections, random lines are projected to their intersection with the west boundary of the township. Quarter-section corners are established on true lines at forty chains west of said section corners, and the measurement taken from these points to the township line, throws the fractional acreage west of such quarter-section corners established and thus upon the western boundary of the township.

It happens occasionally that the township boundaries are so irregular as not to allow of the foregoing requirements for subdivision, so some of the common irregularities are here noted: We will suppose, for example, that the eastern boundary of the township does not run (for good reasons) on a true meridian, and that the corners established on that boundary are in such positions that they cannot be regularly closed upon; then the western boundary of the first tier of

sections on the eastern side of the township, will be run on a true meridian and all other meridional section lines in that township will be run parallel to this line; however, fractional acreage will be thrown upon the eastern boundary of such a township, as well as upon the north and west boundaries. Another example would be, where the east boundary of a township was without section corners and the north boundary was run eastwardly as a true line, with section corners at regular intervals of 80 chains; the subdivision would proceed then, from west to east, and fractional measurements and areas would be thrown against the irregular east boundary. Where by reason of impassable objects, or other reasons, no part of the south boundary of a township can be regularly established, the subdivision proceeds from north to south and from east to west thereby throwing all fractional measurements and areas against the west boundary.

RUNNING LINES.

In surveying, the marking of trees and brush along lines, is required by law as positively as the erection of monuments or corners. All lines, on which are established the legal corner boundaries, are marked by the following method: Those trees which are intersected by the line (sight trees), have two chops or notches cut on the two sides facing the line, without any other marks whatever. A sufficient number of other trees standing within 50 links of the line, on either side of it, are blazed on two sides diagonally or quartering toward the line, the blazes being opposite each other, coinciding in direction with the line where the trees stand very near it, and approaching each other on the side next the line, the farther away from the line the trees stand. On a trial or random line the trees are not marked in any manner, only the true lines being blazed.

It is generally very easy to pick up a line by the blazes

on the trees, but occasionally it is very difficult owing to the fact that at times the axman was negligent. Where he had difficulty in traveling on steep hillsides or in dense underbrush, you will find very few blazes along the line, showing he was too busy here making his way to mark the line. Trees blazed to mark the line, were generally marked about four feet from the ground, however, in the pine woods you will often find them much higher, as if scored by an axman on horseback.

If you are in doubt as to whether marks or scores on trees are blazes, examine carefully the bark at the upper edge of the mark, and no matter how old, you can invariably tell if the mark was made with an axe, or if the abrasion was only the result of a falling snag or limb striking the tree. Finding a tree in the forest with blazes on both sides—the blazes being old enough for the time the line was surveyed—then set your compass and see if the blazes correspond to a north and south or an east and west line. If the tree is really a line tree you will if you extend a line the proper direction from it, soon discover another tree with the same blazes as the first tree discovered, and so on until you reach a corner.

Surveyors are required to record in their field notes the points in measurement where the line crosses streams, hilltops, etc. Should you have access to the field notes, or if you will calculate these distances from the established corners on the line by examining your blue-print, it will be very helpful in determining the approximate location of a corner, which if still in existence, can be easily found.

If in running a line the surveyor should encounter an impassable obstacle such as a swamp, pond, or marsh (not meanderable,) the line is prolonged by triangulation or right-angle offsets across such obstruction. As a guide to alinement and measurement, the line is perpetuated by establishing at the margins of the obstruction a witness point (W P).

Should it happen that the point for a legal corner fall in the obstruction, then if the distance to said corner in the obstruction is less than 20 chains, instead of erecting a witness point, a witness corner is established (W C).

MEANDERING.

Streams of certain character and bodies of water large enough to be of note, are meandered. By meandering, we mean that the surveyor follows by a succession of lines all the minute windings of the borders of that stream or body of water, in order that the borders can be definitely located and the amount of acreage thrown into fractions along such borders. In meandering streams proceeding down stream, the bank on the left hand is termed the left bank and the bank on the right hand is termed the right bank. Only navigable streams and those more than three chains wide are meandered with the following exceptions: Streams which are less than three chains wide and so deep, swift and dangerous as to be impassable through the agricultural season, are meandered, where there are good agricultural lands along the shores. Tide water streams, whether more or less than three chains in width, are always meandered.

To definitely locate the starting points for meandered lines, meander corners (M C) are erected at the intersection of the meandered lines with those of standard, township, or section lines regularly established. These are called regular meander corners. Those meander corners established on lines belonging to the system of rectangular surveying not identical with standard, township, or section lines; i.e., subdivisional lines of a section, are called special meander corners (SMC). Meander corners on a line not belonging to the system of rectangular surveying, are called auxiliary meander corners (AMC).

We have stated previously in a general way, the principal corners necessary to perpetuate rectangular surveying. We will now try to explain more fully these various corners, so they may be identified when found.

The exact points for corners are perpetuated, by raising a mound over a deposit, by firmly setting a stone, by driving a stake, by marking a stone ledge, or by marking a tree which happens to come in place. The exact points to be perpetuated as corners are often not so well marked as the objects which are used to witness them. In prairie country, pits are dug and a mound raised, as accessories, while in a timbered country trees are scored (facing corner) and marked with the township, range and section numbers they identify. These trees, or accessories of a corner, are called bearing trees (B. T.), and their exact position in distance and direction from the corner is recorded in the field notes. Sometimes as an accessory to a corner, a large stone or cliff, being close at hand, the surveyor may mark it as an accessory. It would be called a bearing object, and would be marked with the letters B. O. in addition to the township, range, and section it identifies.

For emphasis, the following paragraphs are set apart to describe abbreviations as used in marking corners and accessories:

S. C.—Standard Corner. The mark necessary, in addition to township, range, and section, on any corner erected on a base line or standard parallel.

C. C.—Closing Corner. Where lines are run at right angles to, and intersect a line already established at a point to the right or left of an established corner more than the allowable limits of 50 links, a new corner is erected called a closing corner. In addition to the marks for township, range, and section on that corner, the letters C. C. are added.

T.—Township.

R.—Range.

S.—Section.

¼ S.—Quarter-section Corner. A point equidistant between two section corners.

M. C.—Meander Corner. The point where any regular standard, township or section line intersects the borders of a meanderable stream or body of water.

S. M. C.—Special Meander Corner. A meander corner established on any line belonging to the system of rectangular surveying, when that line is not a standard, township, or section line, e. g., lines subdividing the interior of a section.

A. M. C.—Auxiliary Meander Corners. Meander corners on a line not belonging to the system of rectangular surveying.

B. T.—Bearing Tree. An accessory to a corner.

B. O.—Bearing Object. An accessory to a corner.

W. C.—Witness Corner. A corner established on a line to witness the position of a regular corner, when that corner falls within an obstruction (not meanderable), or where that corner would be apt to be destroyed by the elements later. A witness corner thus established, must be within twenty chains of the regular corner which would fall within the obstruction.

W. P.—Witness Point. A point erected to mark the limits of an inaccessible marsh or other obstruction (not meanderable), when the margin of that obstruction is more than twenty chains from a regular corner which would fall within such obstruction.

The following are the different kinds of corners necessary to perpetuate certain points established in surveying:

1. Standard Township Corner.
2. Closing Township Corner.
3. Corner common to four townships.

4. Corner common to two townships only.
5. Corner referring to one township only.
6. Standard Section Corner.
7. Closing Section Corner.
8. Corner common to four sections.
9. Section corner common to two sections only.
10. Section corner referring to one section only.
11. Quarter-section Corner.
12. Standard Quarter-section Corner.
13. Quarter-section corner common to two quarters of only one section.
14. Meander Corner.
15. Special Meander Corner.
16. Auxiliary Meander Corner.
17. Witness Corner.
18. Witness Point.

CORNER CONSTRUCTIONS.

Upon arriving at the point for the establishment of a corner, the surveyor takes into consideration the character of the country, and then the requisites at hand, and uses his own judgment as to the best construction to use. He has the choice of eight different constructions, and we herewith give the general requirements for those constructions:

1. Stone for corner, with pits and mound of earth for accessories.
2. Stone for corner, with mound of stone for an accessory.
3. Stone for corner, with bearing trees for accessories.
4. Post for corner, with pits and mound of earth for accessories.
5. Post for corner, with bearing trees for accessories.
6. Mound of earth raised over deposit of marked stone, glass, charred stake, or quart of charcoal for corner, with pits and stake in one pit, for accessories.

7. Tree in place for corner, with pits and mound of earth for accessories.

8. Tree in place for corner, with bearing trees for accessories.

It would require too much space to elaborately describe each and every one of the constructions for all of the various kinds of corners, so the author refers you to the "Manual of Surveying Instructions for the Survey of the Public Lands of the United States" for that information, and only gives in detail the construction likely to be found in a timbered or partly timbered country.

In the older surveys, the requirements were not so strictly carried out as in later years, and evidences to identify the original corners are sometimes lacking. The surveyor often mentioned in the field notes certain bearing trees, which were not marked as required, but only slightly blazed. Sometimes, also, when there were numerous trees at hand suitable for bearing trees, only a stone was set for a corner. So many corners were established in old timber land surveys by the use of the stake for a corner, without the accessories as required, the stake having decayed, it is almost impossible to arrive at the true position for that corner without actually taking the measurements from the nearest known corner.

The following requirements are necessary for the establishment of corners and their accessories:

"No stones measuring less than 504 cubic inches, or less than 12 inches in length or 3 inches in thickness will be used for corners. Stones 18 inches long or less will be set with two-thirds of their length in the ground and those more than 18 inches long will have three-fourths of their length in the ground.

"When a corner falls on rock in place, or on a boulder, a cross (X) will be made at the exact corner point and wit-

nessed by the proper number of bearing trees (if they are available), and in absence of suitable trees, a mound of stones will be raised. Owing to the difficulty of identifying the corner coming upon a flat rock in place, when only a cross is cut thereon, it is imperative that some adequate witness be used and marked.

"Mounds of stone, or of stone covered with earth, must never be built around the corner stone, but separate. When stones are necessary to hold the corner stone upright and firm, they should be in addition to the witness mound, and not a part of it.

"Corners referring to one, two, or four townships or sections, not identical with standard or closing corners, will be set with their faces directed NE. and SW., and NW. and SE., while all other corners will be set with their sides facing the cardinal points; except corners on boundaries of reservations and private land claims, which will be set squarely in line."

Bearing trees must not be less than 4 inches in diameter, and must not stand over 300 links from the corner they witness; except, where such trees are few but accessible. Bearing trees should be marked with plain letters and Arabic figures, as also should posts for corners. The tool used for this purpose is a scribing-tool or gouge and letters or figures made with any other kind of an instrument are not to be confounded with work done by deputy U. S. surveyors.

SPECIFIC CONSTRUCTIONS FOR TIMBERED COUNTRY.

The following are the specific constructions for Nos. 3, 5 and 8 of the eight constructions possible. In corners common to four sections, all eight specific constructions are given, in order to give the reader a clear idea of all the constructions:

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,——ins. in the ground, for standard cor. of Tps. 13 N., Rs. 21 and 22 E., marked S. C. on N.; with 6 grooves on N. E. and W. faces; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 13 N., R. 22 E., S. 31 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 13 N., R. 21 E., S. 36 B. T.

"5. *Post, with Bearing Trees.*

Set a ——— post. 3 ft. long, 4 ins. sq., 24 ins. in the ground, for standard cor. of Tps. 13 N., Rs. 22 and 23 E., marked

S. C. T. 13 N. on North,

R. 23 E., S. 31 on East, and

R. 22 E., S. 36 on west face; with 6 grooves on north, east, and west faces, from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 13 N., R. 23 E., S. 31 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 13 N., R. 22 E., S. 36 B. T.

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for standard cor. of Tps. 13 N., Rs. 22 and 23 E. I mark

S. C. T. 13 N. on north,

R. 23 E., S. 31 on east, and

R. 22 E., S. 36 on west side; with 6 notches on north, east and west sides; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 13 N., R. 23 E., S. 31 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 13 N., R. 22 E., S. 36 B. T.

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,——ins. in ground, for closing cor. of Tps. 4 N., Rs. 2 and 3 W., marked C. C. on south; with 6 grooves on south, east, and west faces; from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 4 N., R. 2 W., S. 6 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 4 N., R. 3 W., S. 1 B. T.

"5. *Post, with Bearing Trees.*

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for closing cor. of Tps. 4 N., Rs. 2 and 3 W., marked

C. C. T. 4 N. on south,

R. 2 W., S. 6 on east, and

R. 3 W., S. 1 on west face; with 6 grooves on south, east, and west faces; from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 4 N., R. 2 W., S. 6 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 4 N., R. 3 W., S. 1 B. T.

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for closing cor. of Tps. 4 N., Rs. 2 and 3 W., I mark

C. C. T 4 N. on south,

R. 2 W., S. 6 on east, and

R. 3 W., S. 1 on west side, with 6 notches on south, east, and west sides; from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 4 N., R. 2 W., S. 6 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 4 N., R. 3 W., S. 1 B. T.

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,——ins. in the ground, for cor. of Tps. 2 and 3 N., Rs. 2 and 3 W., marked with 6 notches on each edge, from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 3 N., R. 2 W., S. 31 B. T.

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 2 N., R. 2 W., S. 6 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 2 N., R. 3 W., S. 1 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 3 N., R. 3 W., S. 36 B. T.

"5. *Post, with Bearing Trees.*

Set a———post, 3 ft. long, 4ins. sq., 24 ins. in the ground, for cor. of Tps. 2 and 3 N., Rs. 2 and 3 W., marked.

T. 3 N., S. 31 on NE.,

R. 2 W., S. 6 on SE.,

T. 2 N., S. 1 on SW., and

R. 3 W., S. 36 on NW. face, with 6 notches on each edge; from which

(Bearing trees same as No. 3.)

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for cor. of Tps. 2 and 3 N., Rs. 2 and 3 W., I mark

T. 3 N., S. 31 on NE.,

R. 2 W., S. 6 on SE.,

T. 2 N., S. 1 on SW., and

R. 3 W., S. 36 on NW. side, with 6 notches facing each cardinal point; from which

(Bearing trees same as No. 3.)

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,——ins. in the ground, for cor. of Tp. 2 N., R. 5 W., and Tp. 3 N., R. 6 W., on N. boundary Tp. 2 N., R. 6 W., marked with 6 notches on north and west edges; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 2 N., R. 5 W., S. 6 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 3 N., R. 6 W., S. 36 B. T.

"5. *Post, with Bearing Trees.*

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for cor. of Tps. 2 and 3 N., R. 7 W., on west boundary Tp. 3 N., R. 6 W., marked.

T. 2 N., R. 7 W., S. 1 on SW., and

T. 3 N., R. 7 W., S. 36 on NW. face, with 6 notches on north and west edges; from which

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 2 N., R. 7 W., S. 1 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 3 N., R. 7 W., S. 36 B. T.

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for cor. of Tps. 2 and 3 N., R. 7 W., on west boundary Tp. 3 N., R. 6 W., I mark

T. 2 N., R. 7 W., S. 1 on SW., and

T. 3 N., R. 7 W., S. 36 on NW. side, with 6 notches facing north and west; from which

(Bearing trees same as No. 5.)

CORNERS REFERRING TO ONE TOWNSHIP ONLY.

"3. *Stone, with Bearing Tree.*

Set a———stone,——x——x——ins.,——ins. in ground for NE. cor. of Tp. 2 N., R. 6 W., marked with 6 notches on south and west edges; from which

A——,——ins. diam., bears S.——° W.,——lks. dist., marked
T. 2 N., R. 6 W., S. 1 B. T.

"5. *Post, with Bearing Tree.*

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for SW. cor. of Tp. 3 N., R. 6 W., marked

T. 3 N., R. 6 W., S. 31 on NE.,

S. 1 on SE.,

T. 2 N., R. 7 W., S. 1 on SW., and

S. 1 on NW. face, with 6 notches on north and east edges; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked
T. 3 N., R. 6 W., S 31 B. T.

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for SE. cor. of Tp. 4 N., R. 6 W., I mark

S. 6 on NE.,

T. 3 N., R. 5 W., S. 6 on SE.,

S. 6 on SW., and

T. 4 N., R. 6 W., S. 36 on NW. side, with 6 notches facing north and west; from which

A——,——ins. diam., bears N.——° W.,——lks. dist., marked
T. 4 N., R. 6 W., S. 36 B. T.

STANDARD SECTION CORNER.

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,——ins. in the ground, for standard cor, of Secs. 33 and 34, marked S. C. on north; with 3 grooves on east and west faces; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked
T. 13 N., R. 21 E., S. 34 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked
T. 13 N., R. 21 E., S. 33 B. T.

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for standard cor. of Secs. 34 and 35, marked

S. C. T. 13 N., R. 21 on north,

"5. *Post, with Bearing Trees.*

S. 35 on east, and

S. 34 on west face, with 2 grooves on east, and 4 grooves on west face, from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 13 N., R. 21 E., S. 35 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 13 N., R. 21 E., S. 34 B. T.

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for standard cor. of Secs. 35 and 36, I mark

S. C. T. 13 N., R. 22 E. on north,

S. 36 on east, and

S. 35 on west side, with 1 notch on east, and 5 notches on west side, from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 13 N., R. 22 E., S. 36 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 13 N., R. 22 E., S. 35 B. T.

CLOSING SECTION CORNERS.

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,——ins. in the ground, for closing cor. of Secs. 1 and 2, marked C. C. on south; with 1 groove on east and 5 grooves on west face, from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 4 N., R. 3 W., S. 1 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 4 N., R. 3 W., S. 2 B. T.

"5. *Post, with Bearing Trees.*

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for closing cor. of Secs. 1 and 2, marked

C. C. T. 4 N., R. 3 W. on south,

S. 1 on east, and

S. 2 on west face, with 1 groove on east, and 5 grooves on west face; from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 4 N., R. 3 W., S. 1 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 4 N., R. 3 W., S. 2 B. T.

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for closing cor. Secs. 1 and 2, I mark C. C. T. 4 N., R. 3 W. on south,

S. 1 on east, and

S. 2 on west side, with 1 notch on east and 5 notches on west side; from which

(Bearing trees same as No. 5.)

CORNERS COMMON TO FOUR SECTIONS.

"1. *Stone, with Pits and Mound of Earth.*

Set a———stone,——x——x——ins.,——ins. in the ground, for cor. of Secs. 14, 15, 22 and 23, marked with 3 notches on south and 2 notches on east edge; dig pits, 18x18x12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, west of corner.

"2. *Stone, with Mound of Stone.*

Set a———stone,——x——x——ins.,——ins. in the ground, for cor. of Secs. 14, 15, 22 and 23, marked with 3 notches on south and 2 notches on east edge; and raise a mound of stone, 2 ft. base, 1½ ft. high, west of corner. Pits impracticable.

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,—ins. in the ground, for cor. of Secs. 9, 10, 15 and 16, marked with 4 notches on south, and 3 notches on east edge; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 2 N., R. 2 W., S. 10 B. T.

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 2 N., R. 2 W., S. 15 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 2 N., R. 2 W., S. 16 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 2 N., R. 2 W., S. 9 B. T.

"4. *Post, with Pit and Mound of Earth.*

Set a———post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for cor. of Secs. 15, 16, 21 and 22, marked

T. 2 N., S. 15 on NE.,

R. 2 W., S. 22 on SE.,

S. 21 on SW., and

S. 16 on NW. face, with 3 notches on south and east edges; dig pits, 18x18x12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, west of cor.

"5. *Post, with Bearing Trees.*

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for cor. of Secs. 25, 26, 35 and 36, marked

T. 2 N., S. 25 on NE.,

R. 2 W., S. 36 on SE.,

S. 35 on SW., and

S. 26 on NW. face, with 1 notch on south and east edges; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 2 N., R. 2 W., S. 25 B. T.

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 2 N., R. 2 W., S. 36 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 2 N., R. 2 W., S. 35 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 2 N., R. 2 W., S. 26 B. T.

"6. *Mound, with Deposit, and Stake in Pit.*

Deposit a marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for cor. of Secs. 25, 26, 35 and 36; dig pits, 18x18x12 ins., in each sec. 4 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, over deposit.

In SE. pit drive a stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked

T. 2 N., S. 25 on NE.,

R. 2 W., S. 36 on SE.,

S. 35 on SW., and

S. 26 on NW. faces, with 1 notch on south and east edges.

"7. *Tree Corner, with Pits and Mound of Earth.*

A——,——ins. diam., for cor. Secs. 29, 30, 31 and 32, I mark

T. 2 N., S. 29 on NE.,

R. 2 W., S. 32 on SE.,

S. 31 on SW., and

S. 30 on NW. side, with 1 notch on south and 5 notches on east side; dig pits, 18x18x12 ins., in each sec., 5 ft. dist.; and raise a mound of earth around tree.

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for cor. of Secs. 5, 6, 7 and 8, I mark

T. 2 N., S. 5 on NE.,

R. 2 W., S. 8 on SE.,

S. 7 on SW., and

S. 6 on NW. side, with 5 notches on south and east sides; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 2 N., R. 2 W., S. 5 B. T.

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 2 N., R. 2 W., S. 8 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 2 N., R. 2 W., S. 7 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 2 N., R. 2 W., S. 6 B. T.

"3. *Stone, with Bearing Trees.* (Tp. 3 N., R. 7 W.)

Set a ———stone,——x——x——ins.,——ins. in the ground, for cor. of Secs. 28 and 29, marked with 4 notches on east edge; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 3 N., R. 7 W., S. 28 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 3 N., R. 7 W., S. 29 B. T.

"5. *Post, with Bearing Trees.* (Tp. 3 N., R. 5 W.)

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for cor. of Secs. 24 and 25, marked

T. 3 N., S. 25 on SW., and

R. 5 W., S. 24 on NW. face, with 4 notches on north, and 2 notches on south edge; from which

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 3 N., R. 5 W., S. 25 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 3 N., R. 5 W., S. 24 B. T.

"8. *Tree Corner, with Bearing Trees.* (Tp. 3 N., R. 7 W.)

A——,——ins. diam., for cor. of Secs. 22 and 27, I mark

T. 3 N., S. 27 on SW., and

R. 7 W., S. 22 on NW. side, with 4 notches on north, and 2 notches on south side; from which

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 3 N., R. 7 W., S. 27 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked T. 3 N., R. 7 W., S. 22 B. T.

SECTION CORNER REFERRING TO ONE SECTION ONLY.

"3. *Stone, with Bearing Tree.*

Set a———stone,——x——x——ins.,—ins. in the ground, for SW. cor. of Sec. 12, marked with 1 notch on east edge; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 2 N., R. 5 W., S. 12 B. T.

"5. *Post, with Bearing Tree.* (Tp. 2 N., R. 5 W.)

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for SW. cor. of Sec. 12; marked.

T. 2 N., S. 12 on NE.,
R. 5 W., S. 13 on SE.,
S. 13 on SW., and
S. 13 on NW. face, with 1 notch on east edge; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 2 N., R. 5 W., S. 12 B. T.

"8. *Tree Corner, with Bearing Tree.* (Tp. 3 N., R. 5 W.)

A——,——ins. diam., for NW. cor. of Sec. 10, I mark
T. 3 N., S. 9 on NE.,
R. 5 W., S. 10 on SE.,
S. 9 on SW., and
S. 9 on NW. side, with 5 notches on south, and 3 notches on east side; from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 3 N., R. 5 W., S. 10 B. T.

QUARTER-SECTION CORNERS.

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,——ins. in the ground, for ¼ sec. cor. marked ¼ on west face; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked ¼ S. 16 B. T.

A——,——ins. diam., bears N.——° W.,——lks. dist., marked ¼ S. 17 B. T.

"5. *Post, with Bearing Trees.*

Set a———post, 3 ft. long, 3 ins. sq., 24 ins. in the ground, for ¼ sec. cor. marked ¼ S. 21 on west face and 22 on east face; from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked ¼ S. 22 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked ¼ S. 21 B. T.

"8. *Tree Corner, with Bearing Trees.*

A——,——ins. diam., for ¼ sec. cor. I mark ¼ S. 20 on north side and 29 on south side; from which

A——,——ins. diam., bears N.——° W.,——lks. dist., marked ¼ S. 20 B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked ¼ S. 29 B. T.

Note.—Up until the year 1897 the section number was not added to the quarter-section corner, nor to its accessories, so in surveys made before that date, you will find on corners and accessories only the marks ¼ or ¼ S. B. T.

STANDARD QUARTER SECTION CORNER.

"All standard quarter-section corners, on base lines or standard parallels, will have the letters S. C. (for standard corner), precede the marking ¼ or ¼ S., as the case may be; such corners will be established in all other respects like other quarter-section corners.

"When bearing trees are described for standard quarter-section corners, each tree will be marked S. C. ¼ S. B. T."

QUARTER-SECTION CORNERS COMMON TO TWO QUARTERS OF ONLY ONE SECTION.

These corners will be similar in all respects to those that are common to four quarters of two sections.

MEANDER CORNERS.

"3. *Stone, with Bearing Trees.*

Set a———stone,——x——x——ins.,——ins. in the ground, for meander cor. of fractional Secs. 26 and 35, with 1 groove on south face, marked

M. C. on west face; from which

A——,——ins. diam., bears N.——° E.,——lks. dist., marked T. 15 N., R. 20 E., S. 26 M. C. B. T.

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 15 N., R. 20 E., S. 35 M. C. B T.

"5. *Post, with Bearing Trees.*

Set a———post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for meander cor. of fracl. Secs. 25 and 26, marked

M. C. on north,

T. 15 N. on south,

R. 20 E., S. 25 on east, and

S. 26 on west face; from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 15 N., R. 20 E., S. 25 M. C. B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 15 N., R. 20 E., S. 26 M. C. B. T.

"8. *Tree Corner, with Bearing Trees.* (Special meander corner.)

A——,——ins. diam., for a special meander cor, of fracl. east and west halves of Sec. 33, I mark

S. M. C. on north,

T. 15 N. on south,

R. 20 E., S. 33 on east, and

S. 33 on west side; from which

A——,——ins. diam., bears S.——° E.,——lks. dist., marked T. 15 N., R. 20 E., S. 33 S. M. C. B. T.

A——,——ins. diam., bears S.——° W.,——lks. dist., marked T. 15 N., R. 20 E., S. 33 S. M. C. B. T.

You will observe, if you will carefully study the foregoing examples, that they are given for as many different section corners as space would permit; also that the notching of stones, posts, and trees for corners is done in such a manner that by counting the notches, the location of the corner can

be easily determined; e. g., if we have a stone for corner, with 3 notches on east and 4 on south face, it means that the corner is three miles from the township line on the east, and four miles from the south boundary; this would make the corner in question the corner to Sections 9, 10, 15 and 16.

All section corners on township lines are notched on both sides facing the line; the notches corresponding to the number of miles such corners stand, from the two township corners which limit such lines. All interior section corners are notched on south and east sides, to indicate the number of miles such corners are from the south and east boundaries of the township.

By carefully examining every section-corner stone, you will be able to verify by the notches the location of the corner, without taking into consideration any of the accessories of that corner. In case the accessory is a bearing tree, and the marks are deeply set in the tree by overgrowth, with the corner stone still firmly imbedded showing no indications of having been disturbed for many years, the notches can be entirely relied upon to determine the exact position of the corner.

THE DECLINATION OF THE MAGNETIC NEEDLE.

It has previously been explained, that true north is the direction from a given point, which if continued, would eventually pass through the North Pole; i. e., it would be a true meridian. If we use an ordinary magnetic compass with which to determine the exact position of the North Pole, we find we must know how much declination the magnetic needle should require before we can determine the Pole's true position; i. e., we must know how many degrees east or west the needle must point, in order that the line marked N. on the compass should point true north.

From time to time, the U. S. Coast and Geodetic Survey issues an isogonic chart, showing the difference in declination

at all points in the United States. Running southeast, from near the eastern borders of Lake Superior to a point just east of Charleston, South Carolina, is an imaginary irregularly curved line, which is designated on the chart and is known as "the line of no variation." If a magnetic compass is set anywhere on this line, the needle would point directly north; if set anywhere east of the line, it would point west of true north (variation west); and if set west of the line, it would point east of true north (variation east). For example, if the compass is set at New York City, the variation would be about 9° west, while if set at Portland, Oregon, it would be about 22° 30′ east.

For some unknown reason the magnetic declination has been constantly changing. The change noted, on the Pacific Coast, since the first surveys were made, is to the effect that the needle points approximately one degree farther east for the lapse of twenty years of time; for example, if a survey was made in the year 1870 and the lines run on 20° east, it would now, in 1910, require a variation for the same line of about 22° 30′ east.

OBTAINING THE VARIATION.

For a cruiser to obtain the true variation for a line, run several years ago, it is necessary for him to know just what year and variation the old line was run on; then to calculate by the lapse of time, what the variation for the present time should be. This will give you only the approximate variation, but it is a great help in making the trial run. After making the trial run, and finding what the departure is from the corner run to; that is, the distance your line falls to the right or left of the established corner, you can then calculate by the following table just what variation the old line runs on at the present time:

80 chains (1 mile)		60 chains (¾ mile)		40 chains (½ mile)		20 chains (¼ mile)	
Min. of angle	Departure in ins.	Min. of angle	Departure in ins.	Min. of angle	Departure in ins.	Min. of angle	Departure in ins.
1	18.48	1	13.86	1	9.24	1	4.62
15	277.2	15	207.9	15	138.6	15	69.3
30	554.4	30	415.8	30	277.2	30	138.6
45	831.6	45	623.7	45	415.8	45	207.9
60	1108.8	60	831.6	60	554.4	60	277.2

Supposing, for example, that in running a half mile of old line on a variation of twenty degrees east, you fell to the left of the objective corner 277.2 inches (23 ft. 1.1 in.). By referring to the table for departure under the ½ mile column, you find that 277.2 inches in departure represents 30 minutes of angle (½ degree); then it is evident that the needle of the compass was pointing too far east, which threw you to the left of the objective corner; instead of running on twenty degrees east your variation should have been 19°30 east. If you should fall to the right of the objective corner, the method of finding the true variation by measuring the departure, would be just reversed.

INDEX

PART I.

INDEX—Continued

INDEX—Continued

INDEX—Continued

PART II.

INDEX—Continued

INDEX—Continued